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Coastal Projects in China: From Reclamation to Restoration

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Coastal reclamation has expanded land resources and living spaces and contributed significantly to the economic growth and urbanization process in Netherlands, Japan, South Korea, and China. From the 1950s to the 1990s, China witnessed three important phases of coastal reclamation, mainly for agriculture, salt production, and mariculture, respectively. At that time, over 30% of tidal land was reclaimed.[1] After the 1990s, a new circle of coastal reclamation started to meet the needs of rapid urban expansion at various city levels. According to an official report from China Oceanic Information Network in 2010, the authorized area of reclaimed land was 13 598.74 ha, accounting for 7.03% of the nation's sea-use area that year (State Oceanic Administration People's Republic of China, 2011, Figure.1). Particularly, current flourishing reclamation projects at national level, such as Tianjin new coastal district, Caofeidian Industrial Zone in Tangshan City of Hebei Province and the Yellow River Delta High-efficiency Economic Zone in Dongying City of Shandong Province, are expected to push forward the rural−urban transformation greatly for both regional and national development, making the Bohai Bay a new hotspot for coastal reclamation in the coming decades, after East and South China.

Compared with reclamation activities before the 1990s, today's projects are not only to enclose the tidal flats but also to fill in the wetland/coastal water bodies using civil materials. The reclaimed land has been constructed into harbor, seawall, industrial complex, urban district, which will permanently change the geomorphology of the coastal line and the physical processes of the coastal system, exerting even higher impacts on coastal environment and ecosystem. For instance, certain natural interactions, such as the hydrodynamics and sediment processes, between land and sea have been seriously interrupted, leading to shortening of salinity gradient and increase of water eutrophication and pollution, which ultimately results in algae bloom, biodiversity decline and even seawater intrusion.[2,3]

Now, reclamation has increasingly emerged as a hot issue in coastal zones of China. However, several gaps remain in the environmental monitoring after reclamation. Here, we aim at improving the efficiency of long-term and multiple-scale systems for monitoring and managing potential effects of reclamation projects. First, environmental monitoring should be focused on hydro-morphology, eutrophication and pollution as well as organisms in the changing water and sediment systems. The cases from the Northland can provide us with insights into environmental monitoring, such as selection of typical environmental indicators for both abiotic and biotic systems influenced by reclaimed activities.[4] The dominant factors on the coastal environment are variable because of the variety of reclamation activities. For instance, reclamation activities in the Yellow River Delta were carried out mainly for oil industry, so more attention should be paid to the monitoring and assessment of the effects of oil pollution on seawater and sediments. Second, based on the common sample site investigation, spatial pattern of environmental changes should be identified to understand coastal ecosystem responses to the environmental changes at a large scale. Modern geospatial technologies, such as remote sensing and geographic information systems can provide alternative approaches. Time series remotely sensed images can be an ideal data source for retrieving the spatiotemporal information on water quality and soil conditions after reclamation, thus help reveal the underlying mechanism for environmental evolution after reclamation. Finally, reclamation confines the natural area to a narrowed stretch of beach, which has been exacerbated by the sea-level rise induced by global climate change. However, the effects of sea-level rise have been underestimated in most reclamation projects in China. Therefore, we should adopt an integrated study to understand the trend of coastal develop-

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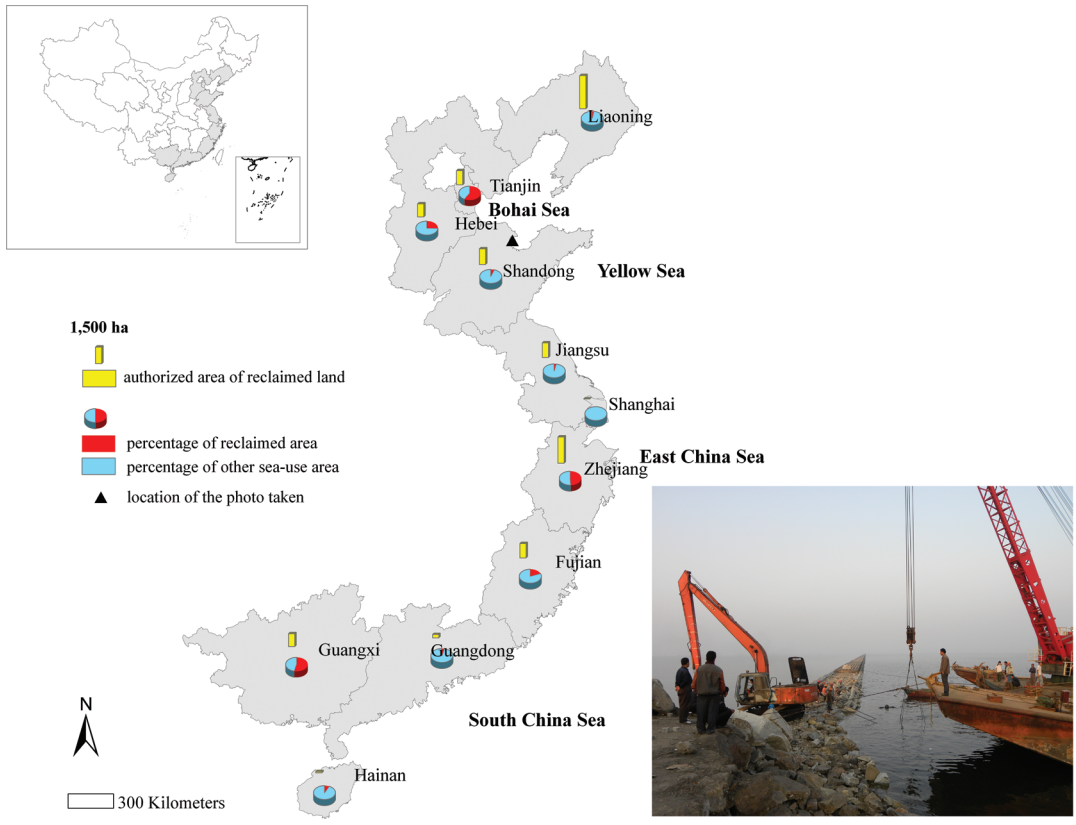

Figure 1. Costal Reclamation in 2010, China. The photo is an ongoing reclaimed project for a new urban district of Weifang, a medium-sized city in Shandong Province, China.

ment and predict potential impacts of global sea level rising. Explicit models combined with global climate change models can be used to simulate the dynamic processes of coastal environments and identify further ecological succession of the reclaimed coastal ecosystems.

In fact, the Chinese government has made significant efforts in developing legislations for coastal reclamation. In 2011, a new government policy was laid down to conduct annual planning for coastal reclamation projects at the national level. With better knowledge of the ecological succession from sea to land, planning policies will play a more positive role in protecting and restoring coastal environments in the future. In addition, understanding of natural processes from sea to land can help improve the ecosystem restoration processes and facilitate the overall planning and management in the reclaimed areas. For instance, several mangrove restoration projects have been initiated or proposed in Shenzhen, China. The revealing of the spatial distribution and temporal pattern of colonization of mangroves could contribute greatly to successful mangrove restoration projects.[5]

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Notes

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